

Claim 1 (Amended twice)

Sub. C2
B16

A liquid-solid circulating fluidized bed system comprising a first liquid fluidized bed, said first liquid fluidized bed being a conventional liquid fluidized bed, means to feed solids into said first fluidized bed adjacent to a first end of said first fluidized bed and means to feed a first fluid into said first fluidized bed adjacent to a second end of said first fluidized bed, said second end being remote from said first end so that said solids and said first fluid flow in counter current, a second liquid fluidized bed, said second liquid fluidized bed being a riser and entraining liquid fluidized bed wherein a means for introducing solids and a means for introducing a second fluid into said second bed are both adjacent to one end of said second fluidized bed so that said solids and said second fluid introduced into said second bed flow concurrently through said second bed from said one end toward another end of said second fluidized bed remote from said one end, first means connecting said first fluidized bed to said second fluidized bed adjacent to said second end of said first fluidized bed and said one end of said second fluidized bed, said first connecting means includes means to feed said solids into said second fluidized bed, second means connecting said first and said second fluidized beds adjacent said first end of said first bed and said other end of said second fluidized bed, said second means connecting includes said means to feed solids into said first fluidized bed.

Please cancel claims 2 through 20 inclusive

Please add new claims 21 to 45 inclusive as follows

- Sub. D1*
Sub. C3
B17
- 21 A liquid-solid circulating fluidized bed system as defined in claim 1 wherein said first and second liquid fluidized beds are substantially vertical columns.
- 22 A liquid-solid circulating fluidized bed system as defined in claim 21 wherein said first end of said first fluidized bed is the top end, said second end of said first fluidized bed is the bottom end, said one end of the second fluidized beds is the bottom end and said other end of said second fluidized bed is the top end.
- 23 A liquid-solid circulating fluidized bed system as defined in claim 22 wherein said first fluid essentially flows upwards and said solids essentially flow downwards to form a counter current flow in said first fluidized bed, and wherein said second fluid and solids both essentially flow upwards concurrently in the second fluidized beds.
- Sub. D1*
24 A liquid-solid circulating fluidized bed system as defined in claim 23 wherein second means connecting said first and said second liquid fluidized beds includes a washer for

washing said solids before they are fed into said first end of said first fluidized bed.

25 A liquid-solid circulating fluidized bed system as defined in claim 24 wherein said second means connecting said first and said second liquid fluidized beds further includes a separator means for separating solids from fluid and exhausting such separated fluid to provide separated solids.

26 A liquid-solid circulating fluidized bed system as defined in claim 24 wherein said second means connecting said first and said second liquid fluidized beds further includes a hydraulic seal between said first and second fluidized beds.

27 A liquid-solid circulating fluidized bed system as defined in claim 23 wherein said first means connecting said first and said second liquid fluidized beds includes a second washer for washing solids adjacent to said second end of said first fluidized before they are introduced into said second fluidized bed.

28 A liquid-solid circulating fluidized bed system as defined in claim 27 wherein said first means connecting said first and said second liquid fluidized beds further includes a separator means for separating solids from fluid and exhausting such separated fluid to provide separated solids

29 A liquid-solid circulating fluidized bed system as defined in claim 27 wherein said first means connecting said first and said second liquid fluidized beds further includes a hydraulic seal between said first and second fluidized beds.

30 A liquid-solid circulating fluidized bed system as defined in claim 1 wherein the recover of ionic products of interest is realized by passing ion exchange particles as the said solids in countercurrent flow with a feed fluid stream that contains said ionic products of interest as said first fluid through the said first liquid fluidized bed for adsorption of said ionic products from said feed stream, transferring said ion exchange particles with said adsorbed ionic products of interest from said first fluidized bed to said second fluidized bed, passing said ion exchange particles with adsorbed ionic products in concurrent flow with an extract buffer solution as said second fluid through said second liquid fluidized bed for desorption of said adsorbed ionic products of interest, separating said extract buffer solution containing said ionic products of interest desorbed from said ion exchange particles to provide regenerated ion exchange particles and returning said regenerated ion exchanged particles into said first fluidized bed to flow in countercurrent with said first

fluid.

31 A liquid-solid circulating fluidized bed system as defined in claim 1 wherein the recover of ionic products of interest is realized by passing ion exchange particles as the said solids in concurrent flow with a feed fluid stream that contains said ionic products of interest as said second fluid through the said second liquid fluidized bed for adsorption of said ionic products from said feed stream, transferring said ion exchange particles with said adsorbed ionic products of interest from said second fluidized bed to said first liquid fluidized bed, passing said ion exchange particles with absorbed ionic products in countercurrent flow with an extract buffer solution as said first fluid through said first fluidized bed for desorption of said adsorbed ionic products of interest, separating said extract buffer solution containing said ionic products of interest desorbed from said ion exchange particles to provide regenerated ion exchange particles and returning said regenerated ion exchanged particles into said second fluidized bed to flow in concurrent with said second fluid.

32 A liquid-solid circulating fluidized bed system as defined in claim 23 wherein the recover of ionic products of interest is realized by passing ion exchange particles as the said solids in countercurrent flow with a feed fluid stream that contains said ionic products of interest as said first fluid through the said first liquid fluidized bed for adsorption of said ionic products from said feed stream, transferring said ion exchange particles with said adsorbed ionic products of interest from said first fluidized bed to said second liquid fluidized bed, passing said ion exchange particles with absorbed ionic products in concurrent flow with an extract buffer solution as said second fluid through said second fluidized bed for desorption of said adsorbed ionic products of interest, separating said extract buffer solution containing said ionic products of interest desorbed from said ion exchange particles to provide regenerated ion exchange particles and returning said regenerated ion exchanged particles into said first fluidized bed to flow in countercurrent with said first fluid.

33 A liquid-solid circulating fluidized bed system as defined in claim 23 wherein the recover of ionic products of interest is realized by passing ion exchange particles as the said solids in concurrent flow with a feed fluid stream that contains said ionic products of interest as said second fluid through the said second liquid fluidized bed for adsorption of

said ionic products from said feed stream, transferring said ion exchange particles with said adsorbed ionic products of interest from said second fluidized bed to said first liquid fluidized bed, passing said ion exchange particles with adsorbed ionic products in countercurrent flow with an extract buffer solution as said first fluid through said first fluidized bed for desorption of said adsorbed ionic products of interest, separating said extract buffer solution containing said ionic products of interest desorbed from said ion exchange particles to provide regenerated ion exchange particles and returning said regenerated ion exchanged particles into said second fluidized bed to flow in concurrent with said second fluid.

Sub. C5
B17
cont.
34 A liquid-solid circulating fluidized bed system as defined in claim 32 wherein second means connecting said first and said second liquid fluidized beds includes a washer for washing said solids before they are fed into said first end of said first fluidized bed, a separator means for separating solids from fluid and exhausting such separated fluid to provide separated solids, and a hydraulic seal between said first and second fluidized beds.

35 A liquid-solid circulating fluidized bed system as defined in claim 33 wherein second means connecting said first and said second liquid fluidized beds includes a washer for washing said solids before they are fed into said first end of said first fluidized bed, a separator means for separating solids from fluid and exhausting such separated fluid to provide separated solids, and a hydraulic seal between said first and second fluidized beds.

36 A liquid-solid circulating fluidized bed system as defined in claim 32 wherein said first means connecting said first and said liquid second fluidized beds includes a second washer for washing solids adjacent to said second end of said first fluidized before they are introduced into said second fluidized bed, a separator means for separating solids from fluid and exhausting such separated fluid to provide separated solids, and a hydraulic seal between said first and second fluidized beds.

37 A liquid-solid circulating fluidized bed system as defined in claim 33 wherein said first means connecting said first and said second liquid fluidized beds includes a second washer for washing solids adjacent to said second end of said first fluidized before they are introduced into said second fluidized bed, a separator means for separating solids

from fluid and exhausting such separated fluid to provide separated solids, and a hydraulic seal between said first and second fluidized beds.

- 38 A liquid-solid circulating fluidized bed system as defined in claim 32 wherein said ionic product is a protein and said first fluid is a fermentation broth.
- 39 A liquid-solid circulating fluidized bed system as defined in claim 33 wherein said ionic product is a protein and said first fluid is a fermentation broth.
- 40 A liquid-solid circulating fluidized bed system as defined in claim 32 wherein said ionic product is a metal and said first fluid is sea water.
- 41 A liquid-solid circulating fluidized bed system as defined in claim 33 wherein said ionic product is a metal and said first fluid is sea water.
- 42 A liquid-solid circulating fluidized bed system as defined in claim 32 wherein said ionic product is an enzyme and said first fluid is dextrose syrup.
- 43 A liquid-solid circulating fluidized bed system as defined in claim 33 wherein said ionic product is an enzyme and said first fluid is dextrose syrup.
- 44 A liquid-solid circulating fluidized bed system as defined in claim 1 wherein said first liquid fluidized bed is an absorber for separating ionic products of interest, said second liquid fluidized bed is a desorber for desorption of said ionic products, said solids are ion exchange particles, said first fluid is a feed fluid stream that contains said ionic products of interest, and said second fluid is an extract buffer solution that is suitable for desorption of said ionic products from said ion exchange particles.
- 45 A liquid-solid circulating fluidized bed system as defined in claim 1 wherein said first liquid fluidized bed is a desorber for desorption of ionic products, said second liquid fluidized bed is an absorber for separating ionic products of interest, said solids are ion exchange particles, said second fluid is a feed fluid stream that contains said ionic products of interest, and said first fluid is an extract buffer solution that is suitable for desorption of said ionic products from said ion exchange particles.

Remarks

Claims 1 and 21 to 45 inclusive are being prosecuted.

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